Independent Oversight Review of the Hanford Site Waste Treatment and Immobilization Plant Construction Quality

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Acronyms

ACI	American Concrete Institute
ASME	American Society of Mechanical Engineers
BOF	Balance of Facilities
BNI	Bechtel National, Incorporated
CDR	Construction Deficiency Report
CFR	Code of Federal Regulations
CM	Commercial Grade
CRAD	Criteria Review and Approach Documents
DOE	U.S. Department of Energy
DOE-WTP	DOE-ORP Waste Treatment Plant Project Office
FWCL	Field Welding Checklist
HLW	High-Level Waste
LAB	Analytical Laboratory
LAW	Low-Activity Waste
M&TE	Measurement and Test Equipment
MSOW	Management Suspension of Work
NCR	Nonconformance Report
NDE	Nondestructive Examination
NQA-1	Nuclear Quality Assurance
ORP	Office of River Protection
OFI	Opportunity for Improvement
P&ID	Piping and Instrumentation Diagram
PICA	Post Installed Concrete Anchor
PIER	Project Issues Evaluation Report
PMI	Positive Material Identification
psi	Pounds per square inch
PTF	Pretreatment Facility
Q	Quality-Related
QA	Quality Assurance
QC	Quality Control
SSC	Structures, Systems, and Components
WTP	Waste Treatment and Immobilization Plant

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Waste Treatment and Immobilization Plant Construction Quality

1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Enforcement and Oversight (Independent Oversight) within the Office of Health, Safety and Security (HSS) conducted an independent review of selected aspects of construction quality at the Hanford Site Waste Treatment and Immobilization Plant (WTP). The review, which was performed March 4-8, 2013, was the latest in a series of ongoing quarterly assessments of construction quality performed by Independent Oversight at the WTP construction site.

2.0 SCOPE

The scope of this review encompassed various topics, including observation of a concrete placement in the High-Level Waste (HLW) facility and three pneumatic pressure tests. Independent Oversight examined nonconformance reports (NCRs) and construction deficiency reports (CDRs) identified by Bechtel National, Incorporated (BNI) under its corrective action program, as well as corrective actions to address deficiencies identified in installation of post installed concrete anchors (PICAs). Independent Oversight also reviewed the BNI self-assessment program in the construction organization, the program that controls measurement and test equipment (M&TE), and the results of quality control (QC) tests performed on samples of concrete placed in the HLW facility.

In addition, Independent Oversight reviewed various construction quality documents and conducted several construction site walkthroughs, concurrent with the DOE Office of River Protection (ORP) WTP Project Office (DOE-WTP) staff. During the walkthroughs, Independent Oversight observed pressure testing of piping and a concrete placement in the HLW facility. Independent Oversight also examined specifications and procedures that control installation of PICAs, structural concrete, M&TE, and pressure testing of piping systems.

3.0 BACKGROUND

ORP was established in 1998 to manage the 56 million gallons of liquid or semi-solid radioactive and chemical waste stored in 177 underground tanks at the Hanford Site. ORP serves as DOE line management for two functions: the Tank Farms, which maintain the 177 underground storage tanks; and the WTP, which is responsible for retrieval, treatment, and disposal of the waste stored in the underground tanks. The WTP is an industrial complex for separating and vitrifying radioactive and chemical waste stored in the underground tanks. The WTP complex consists of five major components: the Pretreatment Facility (PTF) for separating the waste; the HLW and Low-Activity Waste (LAW) facilities where the waste will be immobilized in glass; the Analytical Laboratory (LAB) for sample testing; and the balance of facilities (BOF) that will house support functions. The WTP is currently in the design and construction phase. Design and construction activities at WTP are managed by BNI under contract to ORP. Construction oversight is provided by DOE-WTP staff, specifically by the DOE-WTP Construction Oversight and Assurance Division. Because of the safety significance of WTP facilities, Independent Oversight has scheduled quarterly reviews to assess the quality of ongoing construction.

4.0 METHODOLOGY

This independent review of the WTP construction project was conducted in accordance with applicable sections of Nuclear Facility Construction Criteria Review and Approach Documents (CRADs) HSS-CRAD-45-52, *Piping and Pipe Supports*, HSS-CRAD-45-53, *Mechanical Equipment Installation*, HSS-CRAD-64-15, *Structural Concrete*, and HSS-CRAD-64-20, *Feedback and Continuous Improvement Inspection Criteria and Approach - Contractor*.

5.0 RESULTS

Activities examined by Independent Oversight during the review are discussed below. Each activity is briefly described, followed by a discussion of the review performed by Independent Oversight. Conclusions are summarized in Section 6, Opportunities for Improvement (OFIs) are presented in Section 7, and Items for Follow-Up are discussed in Section 8.

NCRs and CDRs

BNI Procedure 24590-WTP-GPP-MGT-044, *Nonconformance Reporting and Control*, defines the requirements for identifying, documenting, reporting, controlling, and dispositioning nonconforming conditions at the WTP associated with quality-related (Q) and commercial (CM) structures, systems, and components (SSC). NCRs are issued to document and disposition Q nonconforming conditions, while CDRs are used to document and disposition CM nonconforming conditions. SSC designated as Q (previously classified as QL) in the design documents are required to be constructed or manufactured in accordance with the WTP Quality Assurance (QA) program, and the American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA-1) standard. SSC designated in the design documents as non-Q, i.e. CM, are constructed in accordance with CM standards such as the Uniform Building Code or are purchased as CM items from vendors who are qualified as CM grade suppliers.

Independent Oversight reviewed the 60 NCRs issued by BNI between December 4, 2012 and March 7, 2013, and a sample of 60 of the approximately 250 CDRs issued by BNI between December 4, 2012 and March 7, 2013 to evaluate the type of nonconforming issues that were identified, subsequent corrective actions, and the apparent cause of the nonconforming conditions.

Approximately 25 percent of the NCRs were initiated to document construction or installation errors, or damage to installed components resulting from construction activities. Design/engineering issues such as drawing or design errors accounted for 15 percent of the NCRs. The remaining NCRs, approximately 60 percent of the total, were issued to resolve equipment and hardware procurement problems. Examples of these procurement problems included hardware/components that were delivered to the site without the required supporting documentation demonstrating compliance with purchase specifications, improperly labeled hardware, hardware/equipment that did not comply with project specification requirements, and missing parts or damage that occurred during transit. Corrective actions to address the procurement problems varied from obtaining the required documentation from the vendor to performing rework on site. Some examples of rework performed on site are repairing deficient welds, replacing damaged gaskets in valves, or replacing incorrect fastener assemblies (bolts, nuts, and washers) in components. In cases when extensive rework is required, or the item delivered to the site does not comply with the purchase specifications, the hardware is rejected and returned to the vendor.

Nine of the procurement related NCRs were initiated to document and disposition inadequate quality verification records supplied by vendors documenting fabrication of nine vessels/tanks that have been installed in the black cells and are classified as Q. The purchase orders for the tanks required records

documenting positive material identification (PMI) for all materials (steel plate and weld filler materials) used to fabricate the tanks; records documenting all welding activities, including welder qualification records, welding procedures, welding checklists, and weld repairs; nondestructive examination (NDE) records for 100 percent of the welds; and hydrostatic testing for each tank. Deficiencies in the records for the nine tanks were identified by BNI during a secondary documentation review. These deficiencies included missing PMI records, illegible records, incomplete welding records, incomplete NDE records, incomplete hydrostatic pressure test records, missing signatures on records, and references to outdated purchase orders or incorrect design documents. BNI engineering is currently performing a detailed review to determine extent of corrective actions necessary to resolve the issues regarding the vessels/tanks. The secondary documentation review is ongoing for other vessels/tanks installed in the black cells and may result in initiation of additional NCRs.

The CDRs that Independent Oversight reviewed were issued to document the following types of nonconforming conditions: 18 for procurement issues, 12 for construction deficiencies, 3 related to design errors, and 27 for deficiencies in installation of PICAs in the LAB and BOF. Additional CDRs initiated related to deficiencies in installation of PICAs are discussed in the section titled Deficiencies in Installation of PICAs.

Independent Oversight determined that, for the completed NCRs/CDRs reviewed, the BNI engineering organization developed appropriate corrective actions to disposition the identified problems.

Program for Control of Measurement and Test Equipment

Independent Oversight reviewed the program for control of M&TE used for construction, inspection, and testing activities. Examples of M&TE include torque wrenches used for installation of PICAs and various other components, thermometers used for inspections and testing activities, pressure gauges used in testing activities, and tension measuring devices used in electrical cable pulling activities. Independent Oversight reviewed BNI Construction Procedure 24590-WTP-GPP-CON-7102, *Control of Measuring and Test Equipment*. This procedure describes the process for the control and calibration of M&TE required by the BNI QA Program, ASME NQA-1, and DOE Order 414.1C, *Quality Assurance*.

Calibration of M&TE is performed by an offsite laboratory accredited by a nationally recognized accreditation service agency approved by the International Laboratory Accreditation Cooperation. M&TE is calibrated to National Institute of Standards and Technology recognized standards. In some cases, equipment must be returned to the original equipment manufacturer for periodic calibration. An M&TE database is maintained that records the following information: equipment name, model number and serial number, range/size, acceptance tolerance/required accuracy, calibration interval, last calibration date and calibration due date. Calibration intervals vary depending on the type of M&TE, but typically do not exceed one year.

Independent Oversight examined the M&TE lab where M&TE is stored and reviewed the controls for issuing and maintaining M&TE. The M&TE lab is maintained as a level "B" storage area, temperature and humidity controlled, as specified in NQA-1. Access to the M&TE lab is restricted to authorized QC personnel assigned by the field QC manager to maintain, control, and issue M&TE. Independent Oversight observed issue of M&TE to construction personnel, including construction craftsmen, field engineers, and QC personnel. When M&TE is checked out, the date, identification of the user, the work package and work scope where M&TE is to be used, and calibration data is recorded. The M&TE user is responsible for verifying that the M&TE is appropriate for use on the planned work or test activity, and for ensuring the correct range, accuracy level, and instrument tolerance is selected for use in the work or test activity. M&TE users maintain control of the M&TE issued to them; document work where the

M&TE was used in construction records; and report lost, damaged, or suspected performance issues to the M&TE lab.

When M&TE is returned (checked in) to the M&TE lab, the M&TE QC lab personnel inspect the M&TE, record the return date, and verify the systems/components tested are entered into the M&TE database. M&TE QC lab personnel also perform a calibration verification check at the range the M&TE was used in the field to verify the M&TE is in tolerance. The calibration check is documented in a record titled Calibration Verification Report. If the M&TE is found to be out of tolerance, the M&TE is tagged as "out of tolerance" and placed in a hold area, pending repair, recalibration, or disposal. Work that was tested with suspected out of tolerance M&TE is evaluated to determine if rework is necessary. The evaluation is documented in a record titled Evaluation Report for Work Inspected/Tested with Out of Tolerance or Suspect M&TE. An NCR or CDR is initiated if appropriate.

Although not required by Construction Procedure 24590-WTP-GPP-CON-7102, M&TE is normally returned to the M&TE lab at the end of each work day. The M&TE database is then updated, and a calibration verification check is usually performed on a daily basis. This practice prevents the potential use of an out of tolerance M&TE for an extended period of time and reduces any rework necessitated by an out of tolerance M&TE. M&TE lab personnel stated that there are some cases where M&TE remains checked out for the full Monday through Thursday work week, but the M&TE is returned prior to the weekend. M&TE required for weekend work is checked out on Thursday and checked in on Monday.

Independent Oversight performed a cursory review of the M&TE database, and reviewed a sample of Calibration Verification Reports and Evaluation Report for Work Inspected/Tested with Out of Tolerance or Suspect M&TE. Control of M&TE at the WTP site is good.

Deficiencies in Installation of PICAs

PICAs are installed in the concrete structure after the concrete has hardened and attained its design strength to provide anchorage for equipment in locations where embedded plates and cast in-place anchor bolts are not available. The types of hardware supported by PICAs include structural steel platforms, pipe supports, instrument racks, transformers, electrical components, conduit and instrument supports, and other types of hardware and components. BNI Specification No. 24590-WTP-3PS-FA02-T0004, *Engineering Specification for Installation and Testing Post Installed Concrete Anchors and Drilling/Coring of Concrete*, and BNI Construction Procedure 24590-WTP-GPP-CON-3205, *Post Installed Concrete Anchors*, specify the technical requirements for installation, inspection, and testing of PICAs.

PICAs used in Commercial Grade (CM) applications include wedge, drop-in, powder actuated, concrete screw type, and adhesive/grouted (installed using either cement or epoxy grout). The most common type of CM PICA used at WTP is the wedge type, which is installed by drilling a cylindrical hole in the concrete using an ordinary masonry/concrete drill bit, inserting the anchor, and setting the anchor by using a calibrated torque wrench to mechanically expand the anchor into the side of the drilled hole. The specified torque values are listed in the installation procedure for each size (diameter) anchor. The anchor installers' skills and their strict adherence to the anchor installation instructions are necessary if the anchors are to comply with design requirements and be capable of supporting the design loads. Locations of CM anchors are determined based on the need for a PICA to support a component at a specific location.

In September 2011, during the DOE-WTP review of pipe support installation records, DOE-WTP personnel identified several types of discrepancies involving incorrect or missing data documenting installation of CM PICAs for CM pipe supports. On September 21, 2011, BNI issued Project Issues

Evaluation Report (PIER) number 24590-WTP-PIER-MGT-11-0918-C, *Post Installed Concrete Anchor (PICA) Documentation*. The action item for the PIER required review of the PICA records for all anchors installed between July 19, 2010, and May 2012. After completing this review, field engineering determined that additional actions were necessary to resolve PICA documentation and installation issues. The review of PICA records identified a new concern involving incorrect tension loads that may have been applied when testing the completed installation of some PICAs. BNI also concluded that reviewing the PICA records was not sufficient to resolve the documentation issues, but actual physical inspections of PICA installations were required. BNI issued PIER Number 24590-WTP-PIER-MGT-12-1246-B, Rev. 0, *Post Installed Anchor Bolt Installation and Documentation*, to perform additional actions to resolve questions concerning installation of the CM PICAs and the PICA installation records. These actions included reviewing the construction installation procedure, performing walkdown inspections to examine installed PICAs, and reviewing PICA installation records.

The results of the re-inspection effort for CM PICAs were discussed with BNI engineers. The re-inspection effort identified numerous installation discrepancies including insufficient embedment depths, insufficient spacing between adjacent PICAs, application of incorrect torque when installing some types of PICAs, loose nuts and missing washers. CDRs were initiated to document and disposition the incorrectly installed PICAs. The CDRs were evaluated by Engineering who determined, in most cases, that the incorrectly installed PICA would support the applied load (i.e. "Use-as-is"). Rework was required to correct installation errors for approximately ten percent of the incorrectly installed PICAs. Due to the large number of installation errors identified during the initial review discussed above, BNI decided is to expand their re-inspection program and perform walkdowns to inspect all CM PICAs installed on the WTP project. There are approximately 1850 records documenting installation and inspection of CM PICAs. The number of PICAs represented by each record varies, typically between four and ten. As of March 5, 2012, the walkdowns were completed for the PICA installations documented on approximately1080 records. Installation errors were identified on one or more PICAs documented on 350 of the records. Additional CDRs were written to disposition the errors. Engineering has completed evaluation for approximately half of these CDRs. In most cases, Engineering concluded the installed PICAs could support the applied loads ("use-as-is"), but some additional rework has been required. The causes of the installation deficiencies appear to have resulted from inadequate PICA installation instructions and procedures, and an inadequate inspection program. Inspections of the CM anchors are performed by field engineers. QC inspectors do not inspect CM anchors. The PICA installation procedures are being revised. CM PICA installation has been controlled by a management suspension of work (MSOW) until the procedures are revised and field engineers and craft personnel receive training on the revised instructions. Prior to installing any anchors, the PICA installation record for structural anchor bolts is reviewed and approved by construction management per the partial release criteria of 24590-WTP-MSOW-MGT-12-0019.

PICAs used in Q applications were not included in this review for the following reasons: (1) The only types of PICAs used in Q applications on the WTP project are the undercut type (also used in some CM applications), which are installed by drilling a hole in the concrete using a special type of drill bit that flares out to form a cone shaped, or undercut, hole at the bottom of the drill hole, installing the anchor in the hole and expanding it into the undercut area using a hydraulic jack so that the tensile load from the bolt is transferred into the concrete by the anchor bearing against the undercut hole; (2) Locations of the undercut anchors are shown on design drawings so spacing between anchors is controlled; and (3) QC inspectors perform independent inspections of 100 percent of the Q anchors which includes verifying correct hole depth and use of correct load on the hydraulic jack to expand the anchor.

A causal analysis is being performed by BNI to determine the factors that resulted in the deficiencies in the installation of the PICAs. Independent Oversight determined that the BNI approach to determine

extent of condition was adequate. Proposed revisions to the PICA specification and construction procedure are being evaluated to clarify PICA installation instructions.

Management Assessment Program

Independent Oversight reviewed the BNI self-assessment program that is being implemented to comply with the DOE QA program requirements specified in Criterion 9 of 10 CFR 830.122 and DOE Order 414.1C. Self-assessments provide opportunities to identify problems with work processes and completed work activities. The BNI Quality Assurance Manual describes the assessment processes utilized to monitor QA activities. These processes include management assessments, self-assessments, audits, and surveillances. Independent Oversight reviewed BNI Construction Procedure 24590-WTP-GPP-MGT-036, Rev. 2, *WTP Self Assessment*. This procedure describes a process for managers and employees to use to perform self-critical evaluations of their work processes and activities to ensure work is being performed as expected and to monitor work results to ensure completed work meets project requirements. The responsible manager assigns individuals or teams to perform the self-assessment in a particular subject area. Lines of inquiry are developed to address the scope of the assessment, and the self-assessment is conducted by observing work in progress, interviews, document reviews, or data collection and evaluation.

Self-assessments are classified in BNI Procedure 24590-WTP-GPP-MGT-036 as either compliance based or performance based. The procedure defines a compliance-based assessment as an assessment in which the primary focus is to determine if work items were completed in accordance with a procedure, requirement, standard, or other implementing document. A compliance-based assessment typically includes a review of documentation to measure whether those performing the task are following the prescribed method or rule, and includes only minimal observation of work being performed. The procedure defines a performance-based assessment as an assessment that evaluates work being performed. In addition to ensuring work items are completed in accordance with a procedure, requirement, standard, or other implementing document, a key objective of a performance-based assessment is actual observation of ongoing work activities, followed by performing an evaluation based on improving performance areas of that activity. In the section of the procedure titled Overview, there is a declaration that WTP places a high degree of importance on performance-based assessments. The procedure further states that a performance-based assessment is an excellent means of positively affecting the products or services that result from a process.

Independent Oversight reviewed the self-assessment reports documenting the 47 self-assessments performed in the WTP construction organization in 2011 and 2012 (19 self-assessments performed in 2011 and 28 self-assessments performed in 2012). The focus areas for the self-assessments included: 13 self-assessments of construction safety; 2 self-assessments of the construction training program; 13 self-assessments of completed construction records; 6 self-assessments of the material handling and material storage program; 6 self-assessments of work packages and the work control program; 2 self-assessments of PIER closure; 2 self-assessments of welding inspection results; 1 self-assessment of the construction turnover process; 1 self-assessment of rod hanger installation errors; and 1 self-assessment of the construction self-assessment program. The field engineering organization also performs an annual assessment that is a high level overview of the construction quality program. This assessment reviews the program requirements for document control, material control, QC, nonconformance control, M&TE control, training, records retention, and subcontractor control.

With the exception of the self-assessment to review the construction turnover process, the majority of self-assessments performed to review field engineering activities were reactive (i.e., in response to issues identified by QA or the DOE-WTP staff). Few of the self-assessments performed to review and evaluate field engineering activities in 2011 and 2012 could be classified as performance-based assessments. The

self-assessments of the completed construction records were prompted by errors or omissions in records identified during reviews conducted by the DOE-WTP staff. Records reviewed included those completed by the field engineering staff documenting installation of piping, mechanical equipment, electrical components, and welding activities. Based on the results of these compliance-based self-assessments of various types of records, WTP management decided to enhance the process field engineering personnel follow when reviewing records for completed construction activities.

Discussions with the Manager of Field Engineering disclosed that the enhanced review process will require a more detailed technical review of the construction records. These discussions also disclosed that two construction procedures, those for piping installation and pipe support installation, had been revised to incorporate the requirements for the detailed technical review of the construction records. Revision of other construction procedures is in progress to require the 100-percent technical review. The Manager of Field Engineering indicated that an expectation of the enhanced technical review process will be that the technical reviewer(s) target performing field walkdowns to examine ten percent of the installed hardware.

Independent Oversight reviewed Construction Procedures 24590-WTP-GPP-CON-3503, Rev. 6B, *Aboveground Piping Installation*, dated February 28, 2013, and 24590-WTP-GPP-CON-3509, Rev. 2D, *Pipe Support Installation*, dated February 28, 2013, that were revised to require the 100-percent technical review of the pipe inspection and pipe support inspection records. Previous revisions of these procedures stated that these reviews were quality reviews, not technical reviews. The quality review was defined as a review to verify that records were complete (i.e., all blocks filled in) and legible. The technical accuracy of the data recorded on the records was not verified as part of the quality review. The new process for completing piping installation and pipe support construction records will require a 100-percent technical review of the data on the records by an independent reviewer, the lead discipline field engineer or designee. The reviewer is required to utilize the installation drawings and change documents to confirm that the correct inspection attributes have been inspected, that any M&TE equipment is recorded and within calibration, that welding documentation is closed, and that other data documenting piping or pipe support installation is complete and accurate. However, the revised procedures do not discuss performance of field walkdowns as part of the process when the technical review of records is performed.

WTP Self Assessment Report 24590-WTP-SAR-CON-12-0007, Assessment of Construction Assessment Program – Self Assessment Program, recommended performance of self-assessments in the areas of structural steel bolting and pressure testing of piping based on issues identified by QA or DOE-WTP. These assessment activities are scheduled to be completed in 2013 and will be performance-based assessments of actual ongoing work.

The self-assessment program within the field engineering organization has not been effective. Most of the self-assessments of field engineering activities completed in 2011 and 2012 were compliance based to examine completed work activities. There have been few assessments that evaluated work being performed. Instead of identifying deficiencies in the work processes when the work is in progress, the self assessments identified deficiencies after the fact. If more performance based self -assessments are performed, deficiencies may be identified earlier improving cost and schedule performance. For example, Self Assessment Report 24590-WTP-SAR-CON-12-0012, Effectiveness Review for 24590-WTP- PIER-MGT-11-0511-B, Rod Hangers Installed/Accepted Incorrectly addresses 200 rod hangers that were installed incorrectly. Another example involves deficiencies in installation of CM PICAs, which have necessitated a complete re-inspection of all installed CM PICAs. The self assessment process utilized by field engineering could be improved by having a higher reliance on performance based assessments and/or completing a higher percentage of performance based self assessments. (See **OFI-1**.)

Concrete Placement Activities

HSS observed a portion of one concrete placement in the HLW facility. This observation involved concrete pour number 3117, a wall between column lines 13 and 14, from column lines F to M, elevation 37.0' to 44' 5 ½". Activities observed included QC testing of fresh mixed concrete for slump, temperature and unit weight, review of concrete batch tickets by QC inspection personnel, placement of the concrete in the forms, and consolidation of the concrete. Specification No. 24590-WTP-3PS-DB01-T0001, *Engineering Specification for Furnishing and Delivering Ready-Mix Concrete*, and Specification No. 24590-WTP-3PS-D000-T0001, *Engineering Specification for Concrete Work*, delineate the technical requirements for concrete quality and concrete work activities at WTP.

HSS reviewed the concrete pour card and verified that it was signed to document that all required construction work and inspections were completed prior to the start of concrete placement. Testing of the concrete was performed in accordance with ASTM standards specified in the project procedures. Test results showed that the delivered concrete met project requirements for slump and temperature. Concrete was sampled and transported to the site concrete laboratory for molding of cylinders for unconfined compression testing. Molding of the cylinders in the lab precludes the necessity of storing the cylinders in curing boxes under controlled environmental conditions. Review of the concrete batch tickets indicated that the proper concrete was being delivered.

Concrete forms were secure and cleaned (debris removed) prior to concrete placement. Equipment to deliver the concrete to the forms was suitable. A sufficient number of vibrators were used for consolidating the concrete. There was sufficient access to the placement for vibrator operators, other construction craftsmen, and QC inspectors. Concrete drop distances were within specification requirements, vibrators were properly used, and excess water did not accumulate in the forms during placement. Inspection of the concrete placement operations by BNI QC inspectors was adequate.

Independent Oversight accompanied a QC inspector while the inspector examined curing of the concrete placement three days after the placement had been completed to verify that the concrete temperature was being maintained above 50 degrees Fahrenheit, as required by Specification No. 24590-WTP-3PS-D000-T0001. The requirement is to maintain the new concrete temperature above freezing for seven days after placement, as recommended by American Concrete Institute (ACI) Standard practice ACI 308R-1, *Guide to Curing Concrete*. Independent Oversight reviewed the post placement inspection data sheet, which recorded the concrete temperature and time to document that concrete curing was being monitored and complied with project and ACI requirements. The concrete temperature was measured using a calibrated infrared thermometer.

Concrete placements activities have been deferred in the PTF due to design and process questions. Concrete placement continues in the HLW although at a slow pace due to reductions in construction craft staffing. Independent Oversight reviewed the results of QC tests performed on concrete samples from four Q concrete placements in the HLW facility completed between December 2012 and February 2013. These tests included slump, temperature, and unit weight testing performed on the freshly mixed concrete and unconfined compression tests performed on concrete cylinders cured in the concrete laboratory for 3 to 28 days. The concrete design strength is based on the unconfined compression strength of concrete cylinders. The cylinders are either 4 inches in diameter and 8 inches high or 6 inches in diameter and 12 inches high. The concrete strength is determined by casting samples of concrete in cylinder-shaped molds, which are moist cured in a field laboratory for a specified period and then subjected to an unconfined compression test. Typically, the design strength at WTP is based on concrete test cylinders cured in the laboratory for 28 days. The results of the unconfined compression tests are used to verify the concrete quality and demonstrate that the concrete meets the design strength requirements. The methods for sampling the concrete, casting and curing the cylinders, and performing the unconfined compression

tests are specified in ASTM standards. At WTP, the unconfined compression strength of the concrete at 28 days generally exceeds the specified design strength by 1000 pounds per square inch (psi) or more for all classes of structural concrete. The quality of concrete at the WTP plant has been good.

Pressure Testing of Piping

Independent Oversight observed three pneumatic pressure tests performed on instrument tubing installed in accordance with ASME Code B31.3. The WTP site work process for conducting the leak testing is specified in Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 8A, P*ressure Testing of Piping, Tubing and Components*. The requirements for pneumatic pressure testing are specified in ASME Code B31.3, Paragraph 345.5, Pneumatic Testing.

Independent Oversight attended the pre-test briefings, reviewed drawings and test data sheets, observed pressurization of the systems to the specified test pressure, observed the minimum hold times, and witnessed the system walkdown and inspection of tubing within the test boundary. During the pre-job briefings, the following items were discussed: safety guidelines, emergency plan, the size and setting of the pressure relief valve, test sequence, test boundaries, test pressure, system pressurization and de-pressurization, inspection activities, and work completion. The pressure test and inspection boundaries were shown on marked-up piping and instrumentation diagrams (P&IDs), and the attached valve line-up sheets listed the test valve position and referenced test plug or blind flange locations. The locations of limited access/safety barriers were established in accordance with procedure requirements by calculating stored energy.

Pressure Test Package 24590-BOF-PPTR-CON-13-0009, Chiller Refrigerant Detection Monitoring System, included the test data sheets, test information, test requirements, valve line-up sheets, and marked-up P&IDs for the pressure test performed on the instrument tubing for the Chiller Refrigerant Monitoring System. The required hold time was 10 minutes at a pressure of 25 psi. Independent Oversight verified that the calibration stickers on the test pressure gauges were current, and that whip restraints were installed on pressure hoses. The system was pressurized to 26 psi and held for 11 minutes, slightly in excess of the pressure test requirements. The walkdowns and inspections of the tubing and fittings were performed by field engineering personnel because the tubing tested was classified as CM. Independent Oversight witnessed the walkdown inspection and reviewed the test data sheets, which recorded the test information, test requirements, required signoffs for pre-test reviews, documentation of measuring and test equipment used, and test results. There were no leaks in the tubing fittings, and the test was declared acceptable. Independent Oversight reviewed the test data sheets and test acceptance by field engineering.

Pressure Test Package 24590-BOF-PPTR-CON-13-0008, Plant System Air, included the test data sheets, test information, test requirements, valve line-up sheets, and marked-up P&IDs for the pressure test performed on tubing classified as CM in a portion of the Plant Air System instrumentation tubing. The test pressure was 15 psi, with a specified hold time of 10 minutes. Independent Oversight verified that the calibration stickers on the test pressure gauges were current, and that whip restraints were installed on pressure hoses. The system was pressurized to 15.2 psi and held for 11 minutes, slightly in excess of the pressure test requirements. The walkdowns and inspections of the instrument tubing and fittings were performed by field engineering personnel. The test was declared acceptable. Independent Oversight reviewed the test data sheets, which recorded the test information, test requirements, required signoffs for pre-test reviews, documentation of measuring and test equipment used, test results, and test acceptance by field engineering.

Pressure Test Package 24590-LAB-PPTR-CON-12-0039, Atmospheric Reference Ventilation System, included the test data sheets, test information, test requirements, valve line-up sheets, and marked-up

P&IDs for the pneumatic pressure test performed on instrument tubing in a portion of the LAB Atmospheric Reference Ventilation System tubing. The piping and instrument tubing within the test boundaries was CM. There were five Q isolation valves at connections to glove boxes and hot cells that were within the test boundary. The pressure test and inspection boundaries were shown on marked-up P&IDs, and the attached valve lineup sheet listed the test valve position and referenced test plug or blind flange locations. Independent Oversight verified that the calibration stickers on the two test pressure gauges were current and that whip restraints were installed on pressure hoses. Independent Oversight observed pressurization of the system to 15 psi design pressure, and observed the minimum 30-minute hold time. The system was actually pressurized to 15.5 psi and held for 31 minutes, slightly in excess of the pressure test requirements. The objective of the test was to verify that there was no leakage by observing that the test pressure remained unchanged (no reduction) during the 30-minute hold time. Independent Oversight verified that there was no reduction in system test pressure during the holding period. The walkdowns and inspections of the Q isolation valves were performed by both QC inspection and field engineering personnel, as required by the test procedure, while the leak checks in the CM piping and tubing were performed by field engineering. WTP site procedures do not require QC inspectors to perform inspections of CM components. No leaks were detected, and the test was declared acceptable.

The three pressure tests witnessed by Independent Oversight were completed in accordance with the requirements of Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 8A. The three tests were successfully completed.

DOE-WTP Welding Inspection Program

The DOE-WTP staff performs independent inspections of one or more inspection attributes for approximately five percent of Q welds and is currently reviewing 100 percent of the weld records. DOE-WTP randomly selects the welds they examine. In addition to randomly selected welds, DOE-WTP places witness points on weld inspection documentation to ensure a variety of welds are inspected by DOE-WTP across all facilities. The witness point requires BNI construction to notify DOE-WTP when the work is scheduled to be performed. The work activity cannot be performed or proceed past that point unless the construction process is inspected by DOE-WTP, or DOE-WTP waives the witness point. Welds selected by DOE-WTP for inspection include structural steel, piping, pipe supports, vessel (tank) welds, and weld repairs. The majority of the welds examined by DOE-WTP are Q, but the DOE-WTP staff are also including some CM welds in their independent inspections.

Independent Oversight observed the fit-up inspection of a structural weld for a rail for the filter cave bridge crane performed by DOE-WTP staff. This weld was preselected by DOE-WTP as a DOE inspection witness point, which are designated as witness points on the field welding checklists (FWCLs). DOE-WTP also reviewed FWCLs and drawings associated with the weld. The DOE-WTP welding inspection program sample reviewed by Independent Oversight was satisfactory.

6.0 CONCLUSIONS

Independent Oversight determined that construction quality at WTP is adequate in the areas that were reviewed. BNI Engineering had developed appropriate corrective actions to disposition the NCRs and CDRs that Independent Oversight reviewed. Concrete quality is good. The program for pressure testing of installed piping is adequate. The M&TE program is controlled in accordance with DOE QA program requirements and is good. BNI is in the process of evaluating corrective actions necessary to address errors in installation of PICAs.

Review of the BNI self-assessment program in the construction organization disclosed that the self-assessments as conducted by the field engineering organization identify deficiencies in completed work rather than deficiencies in work processes.

7.0 OPPORTUNITIES FOR IMPROVEMENT

This Independent Oversight review identified the following OFI. This potential enhancement is not intended to be prescriptive or mandatory. Rather, it is offered to the site to be reviewed and evaluated by the responsible line management organizations and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

OFI-1: Conduct performance based self-assessments of work in progress, rather than only assessing completed work, to provide earlier identification of process problems and allow for savings in both cost and schedule.

8.0 ITEMS FOR FOLLOW-UP

Independent Oversight will continue follow up on inspection of piping, pipe supports, installation of mechanical equipment, and activities related to pressure testing of piping. Independent Oversight will also review corrective actions to address discrepancies identified in the PICA installation process and perform additional review of self-assessments.

Appendix A
Supplemental Information

Review Dates

March 4-8, 2013

Office of Health, Safety and Security Management

Glenn S. Podonsky, Chief Health, Safety and Security Officer
William A. Eckroade, Principal Deputy Chief for Mission Support Operations
John S. Boulden III, Director, Office of Enforcement and Oversight
Thomas R. Staker, Deputy Director for Oversight
William Miller, Deputy Director, Office of Safety and Emergency Management Evaluations

Quality Review Board

William Eckroade
John Boulden III
Thomas Staker
William Miller
Michael Kilpatrick
George Armstrong
Robert Nelson

Independent Oversight Site Lead for Office of River Protection

Robert Farrell

Independent Oversight Team Composition

Joseph Lenahan

Appendix B
Documents Reviewed

- DOE-WTP Surveillance Reports for December 2012 and January 2013
- Construction Procedure 24590-WTP-GPP-CON-3503, Rev. 6B, Aboveground Piping Installation, February 28, 2013
- Construction Procedure 24590-WTP-GPP-CON-3509, Rev. 2D, Pipe Support Installation, February 28, 2013
- Construction Procedure 24590-WTP-GPP-CON-3504, Rev. 8A, Pressure Testing of Piping, Tubing and Components, September 6, 2012
- Construction Procedure 24590-WTP-GPP-CON-3205, Rev. 3C, Post Installed Concrete Anchors, October 17, 2012
- Construction Procedure 24590-WTP-GPP-CON-7102, Rev. 9C, Control of Measuring and Test Equipment, February 28, 2013
- Specification No. 24590-WTP-3PS-DB01-T0001, Rev. 8, Engineering Specification for Furnishing and Delivering Ready-Mix Concrete, March 26, 2007
- Specification No. 24590-WTP-3PS-D000-T0001, Rev. 8, Engineering Specification for Concrete Work, August 17, 2012
- Specification No. 24590-WTP-BOF-3PS-C000-T0001, Rev. 6, Engineering Specification for Material Testing Services, January 18, 2011
- Specification No. 24590-WTP-3PS-FA02-T0004, Rev. 5, Engineering Specification for Installation and Testing Post Installed Concrete Anchors and Drilling/Coring of Concrete, July 7, 2010
- Construction Procedure 24590-WTP-GPP-MGT-043, Rev. 4A, Corrective Action Management, November 30, 2012
- Construction Procedure 24590-WTP-GPP-MGT-044, Rev. 1B, Nonconformance Reporting and Control, March 4, 2013
- Construction Procedure 24590-WTP-GPP-MGT-036, Rev. 2A, WTP Self Assessment, October 8 , 2012
- Design Guide 24590-WTP-GPG-M-017, Rev. 8E, Design Parameters & Test Pressures for Equipment & Piping, February 14, 2013
- Document No. 24590-WTP-QAM-QA-06-001, Rev. 11, Quality Assurance Manual, July 30, 2012
- Construction Deficiency Reports for nonconforming Post Installed Concrete Anchors, numbers 24590-WTP-CDR-CON-12-0612, -0613, -0616 through -0618, -0628, -0632 through -0635; 24590-WTP-CDR-CON-13-0001 through -0004, -0006 through -0011, -0014, -0015,-0018, -0126, -0127, -0129
- Nonconformance Report numbers 24590-WTP-NCR-CON-12-0230, 24590-WTP-NCR-CON-12-0232 through -0244, 24590-WTP-NCR-CON-13-001 through -0018, and 24590-WTP-NCR-CON-13-0020 through -0048. Note: Number 24590-WTP-NCR-CON-12-0231was not issued and 24590-WTP-NCR- CON-13-0019 was cancelled.
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0001, Hazardous Energy Effectiveness Review
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0003, Subcontractor Compliance with Exhibit G, Safety Industrial Hygiene Requirements
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0007, Effectiveness Review – PIER-08-558-B-Expand Extent of Condition for CM Material
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0008, Orbital versus Hand Welding Reject Rate Evaluation

- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0009, Assessment of WTP Use of Computed Radiography
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0010, Piping Inventory Float Point of Contact Assessment
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0011, Review of All Items in the Piping Inventory Float
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0013, Second Quarter Record Assessment for Piping Records
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0015, Second Quarter Record Assessment for Electrical Records
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0016, Second Quarter Record Assessment for Mechanical Records
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0017, Weld Records Review – 2nd Quarter 2011
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0018, WTP Work Package Hazard Analysis Assessment – Work Control
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0021, Floor Covers – HLW and PT
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0022, Scaffold Access and Egress Assessment
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0023, Third Quarter Record Assessment for Piping Records
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0024, Fourth Quarter Record Assessment for Welding Records – Field Welding Checklists (FWCL)
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0025, Scaffold Assessment – Scaffold Activities Across WTP Construction Site
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0027, Construction Review of Engineering Documents
- WTP Self Assessment Report 24590-WTP-SAR-CON-11-0030, Quarterly Record Assessment for Piping Records
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0001, Quarterly Assessment for Weld Records Closed October, November, and December, 2011 – Field Welding Checklists WR25 (Piping) & WR25C (Structural) Both Q and CM All Facilities
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0002, Material Handling and Rigging Effectiveness Review – HLW Formwork Rigging
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0005, Third Quarter Record Assessment for Mechanical Records
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0006, Fourth Quarter Record Assessment for Mechanical Records
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0007, Assessment of Construction Assessment Program – Self Assessment Program
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0008, Third Quarter Record Assessment for Piping Records
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0009, Effectiveness Review of 24590-WTP- PIER-MGT-10-0886-B, DWP Inspection Records not Routed to Third Party Inspector – Third Party Inspector review of All Piping Related DWP Affecting QV Records (QVR)
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0010, Area Safety Walk Down – Distribs, LBL, MNF, PTF, and HLW
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0011, In-Process Welding Documentation Assessment - Welding

- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0012, Effectiveness Review for 24590-WTP- PIER-MGT-11-0511-B, Rod Hangers Installed/Accepted Incorrectly – Construction Facilities
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0014, Wind Breaks in Temporary Facilities – "T" Buildings at the WTP Construction Site
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0015, Check Qual 5560 Application - Construction Training
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0016, Assessment for Welding Records for January, February, March, 2012
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0017, Work Package Assessment on Critical Steps - Work Package Critical Steps
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0018, First Quarter 2012 Record Assessment for Piping Records
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0019, Assessment of Open Structural Welding Records Prior to 03/08/2006- Field Welding Checklists WE-25C Both Q & CM
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0020, First Quarter Assessment on the Adequacy of Construction PIER Closures
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0021, Construction Turnover to Startup Readiness – System Completion Process & Management of the Turnover Punchlist
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0022, Inspection of Electrical Cord Sets 208 Volts to verify Quarterly Inspections – Construction Site
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0024, BEO WTP Crane and Rigging Performance Base Review 21 June 2012 - Crane and Rigging Operations
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0025, Floor Covers – HLW, PT, LAW, LAB and BOF
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0027, Outdoor Storage Review
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0028, Check Qual 5560 Application
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0029, Second Quarter Assessment on the Adequacy of Construction PIER Closures
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0030, LP Gas (Propane) Cylinder Expiration Date Verification
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0033, LAB/BOF - Material Storage Assessment
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0034, Material Storage Assessment
- WTP Self Assessment Report 24590-WTP-SAR-CON-12-0053, Extent of Condition for Non-System Scaffold Components
- System Pressure Test Document No. 24590-LAB-PPTR-CON-12-0039, Atmospheric Reference Ventilation System
- System Pressure Test Document No. 24590-BOF-PPTR-CON-13-0008, Plant System Air
- System Pressure Test Document No. 24590-BOF-PPTR-CON-13-0009, Chiller Refrigerant Detection Monitoring System